CLAIMS

What is claimed is:

1. A swept airfoil comprising:

at least one leading airfoil element having an upper surface and a lower surface;

at least one trailing airfoil element having an upper surface and a lower surface; and

at least one full-span slot defined by the airfoil during at least one transonic condition of the airfoil, the slot allowing a portion of the air flowing along the lower surface of the leading airfoil element to split and flow over the upper surface of the trailing airfoil element so as to achieve a performance improvement in the transonic condition.

2. A swept aircraft wing comprising the airfoil of claim 1.

3. The wing of claim 2, wherein the slot includes an aerodynamically smooth channel defined between the leading and trailing airfoil elements without an unfaired cove.

4. The wing of claim 2, wherein the slot is configured to improve performance of the wing by a criterion selected from one or more of the group consisting of:

an increase in cruise speed;
an increase in lift;
an increase in thickness;
a reduction in sweep;
a reduction in drag; or
a combination thereof.

5. The wing of claim 2, wherein the slot extends spanwise along the wing where airflow separation would occur to add drag at the transonic condition.

6. The wing of claim 2, wherein the slot is configured to push shock waves generated by supersonic flow across the wing to a position further aft on the wing.

7. The wing of claim 2, wherein the slot is configured to increase the drag-divergence Mach number capability of the wing while at least maintaining a comparable aerodynamic efficiency for the wing.

8. The wing of claim 2, wherein the slot is configured to mitigate shock waves and provide a higher cruise speed for the wing.

9. The wing of claim 2, further comprising an actuator structure coupled to the leading and trailing airfoil elements for moving one of the leading and trailing airfoil elements relative to the other element to trim the slot.

10. The wing of claim 2, wherein the actuator structure is configured to trim the slot by at least one action selected from one or more of the group consisting of:

adjusting a gap separating the leading and trailing airfoil elements, the gap defining the slot;

adjusting a relative height between the leading and trailing airfoil elements; and

adjusting an angle between the leading and trailing airfoil elements.

11. The wing of claim 2, wherein the slot includes a plurality of segments longitudinally arranged along the wing, each of the segments being independently adjustable by the actuator structure to allow trimming of the slot differently at different locations along the span.
longitudinally

12. The wing of claim 2, further comprising an actuator structure coupled to the leading and trailing airfoil elements for moving one of the leading

and trailing airfoil elements relative to the other element to close the slot during at least one subsonic condition and to open the slot during the transonic condition.

13. The wing of claim 2, wherein the transonic condition is selected from one or more of the group consisting of a cruise condition and a maneuver.

14. The wing of claim 2, wherein:
the leading airfoil element comprises a main wing portion;
the trailing airfoil element comprises a flap; and
the wing further comprises an actuator structure for trimming the flap during cruise to improve performance of the wing during cruise.

15. An aircraft comprising the airfoil of claim 1.

16. A method for flying an aircraft wing having a leading airfoil element, a trailing airfoil element, and at least one full-span slot defined between the leading airfoil element and the trailing airfoil element during at least one transonic condition, the method comprising trimming the slot during the transonic condition so as to achieve a performance improvement in the transonic condition.

17. The method of claim 16, wherein the transonic condition is selected from one or more of the group consisting of a cruise condition and a maneuver.

18. The method of claim 16, wherein:
the leading airfoil element comprises a main wing portion;
the trailing airfoil element comprises a flap assembly; and
trimming the slot comprises actuating the flap assembly.

19. The method of claim 16, wherein trimming the slot comprises at least one action selected from one or more of the group consisting of:
adjusting a gap separating the leading and trailing airfoil elements, the gap defining the slot;

adjusting a relative height between the leading and trailing airfoil elements; and

adjusting an angle between the leading and trailing airfoil element.

20. The method of claim 16, further comprising closing the slot during at least one subsonic condition of the wing.

21. The method of claim 16, wherein the slot includes an aerodynamically smooth channel defined between the leading and trailing airfoil elements without an unfaired cove.

22. A method for flying a swept aircraft wing comprising using at least one full-span slot defined by the wing to divert a portion of the air flowing along a lower surface of the wing to split and flow over an upper surface of the wing during at least one transonic condition of the wing, the diverting at least delaying airflow separation that would occur to add drag at the transonic condition so as to achieve a performance improvement in the transonic condition.

23. The method of claim 22, further comprising trimming the slot during the transonic condition.

24. The method of claim 22, wherein trimming the slot comprises at least one action selected from one or more of the group consisting of:

adjusting a gap separating a leading element and a trailing element, the gap defining the slot;

adjusting a relative height between the leading element and the trailing element; and

adjusting an angle between the leading element and the trailing element.

25. The method of claim 22, wherein:

the leading airfoil element comprises a main wing portion;

the trailing airfoil element comprises a flap assembly; and

trimming the slot comprises actuating the flap assembly.

26. The method of claim 22, further comprising opening the slot when at or near the transonic condition.

27. The method of claim 22, further comprising closing the slot during at least one subsonic condition of the wing.

28. The method of claim 22, wherein the slot includes an aerodynamically smooth channel defined between the leading and trailing airfoil elements without an unfaired cove.

29. A method for flying an aircraft wing having a main wing portion, a flap assembly, and at least one full-span slot defined between the main wing portion and the flap assembly during cruise, the method comprising actuating the flap assembly during cruise to trim the flap assembly so as to achieve a performance improvement during cruise.

30. The method of claim 29, wherein the slot includes an aerodynamically smooth channel defined between the leading and trailing airfoil elements without an unfaired cove.